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ABSTRACT

This report is one of seven that identify major new and emerging technological advances expected to influence major vocational education program areas and to describe the programmatic implications in terms of skill-knowledge requirements, occupations most directly affected, and the anticipated diffusion rate. Chapter 1 considers technology as process, the relation of technology and productivity, and technology as the arbitrator of work. The first of three sections in chapter 2 presents the procedures used to identify and clarify the most innovative, new, and emerging technologies with implications for vocational education. Brief descriptions of the technologies expected to affect office occupations are included in section 2. Section 3 contains nine essays describing these new and emerging technologies with implications for office occupations: personal computers, database systems, software, inventory control systems, word processing, optical data transmission, office automation (office of the future), alternative work scheduling, and worker participation in management (quality circles). Chapter 3 is an annotated bibliography with citations descriptive of new or emerging technologies, their diffusion, or insights as to their vocational implications. (YLB)



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# TECHNOLOGIES OF THE '80s: THEIR IMPACT ON OFFICE OCCUPATIONS

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# FOREWORD

Productivity is a critical economic concern. Sagging productivity growth coupled with rising costs and heightened foreign competition are placing American business and industry in an increasingly vulnerable position. In an effort to strengthen its competitive position, American business and industry is investing heavily in capital-intensive technology. However, productivity is people-dependent and its improvement conditioned upon their possessing the technical and organizational skills necessary to utilize technology to its fullest advantage. The development of the work skills required to contribute to the revitalization of America is the central challenge to vocational education.

This report is the result of a contract with the U.S. Department of Education, Office of Vocational and Adult Education to investigate the changing role of vocational education resulting from new and emerging technologies. It identifies the major technological advances expected to influence each of the major vocational education program areas and describes the programmatic implications in terms of skills-knowledge requirements, the occupations most directly affected and the anticipated diffusion rates.

An associated project report, "Working for America: A Worker-Centered Approach to Productivity Improvement," is devoted to an examination of worker-centered productivity and a discussion of the organizational and educational strategies for its improvement. A companion monograph entitled "Vocational Education: Its Role in Productivity



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Improvement and Technological Innovation" describes the relationship between productivity and technology and presents mechanisms for state vocational education agency use in productivity improvement and technological innovation.

Technologies described in this paper range from the "hard" technologies with industrial applications, (e.g, robotics and computer-assisted design and manufacture), to "soft" technologies such as alternative work scheduling; (e.g., flexitime, job-sharing); or worker participation in management; (e.g., quality control circles, quality of life groups). Both "hard" and "soft" technologies can be expected to bring rapid and radical change to workers involved in their use. Some technologies may affect only one vocational education instructional area. The effects of other technologies will be felt in several or all of the vocational education instructional areas in varying degrees. In either case, vocational educators must take action to assure the inclusion of the skills demanded by these technologies in their instruction in order to meet the job challenges of the near future.



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# CHAPTER I

# TECHNOLOGY--THE FORCE FOR CHANGE

## TECHNOLOGY AS PROCESS

Technology means many things to many people. Some see technology as the driving force propelling society into the future. Others view it as evidence of an engulfing mechanistic materialism that threatens to destroy our humanistic values. Workers fear that technological advancements will take away their jobs and render their skills obsolete.

All of these are in part true. Undoubtedly, technology influences the future growth and direction of society. Technology is mechanistic and may be used to the detriment of human dignity. Indeed, technological advancements do render certain job skills obsolete. These conditions, however, speak more to the results of technology than to the nature of technology itself.

Technology in essence is the application of information, techniques and tools to material resources so as to achieve desired ends. At the societal level, these desired ends translate into a mix of material goods and services required to satisfy society's wants. Technology provides the ways and means for producing the desired stock of goods and services. Since production implies the use of resources to create products of value, technology provides the means to convert natural resources into material wealth.

Technology, then, can be regarded in the abstract as the process used by a work system to convert inputs into outputs. A work sys-



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tem can be defined as any organization that expends energy (work) to convert resource inputs into outputs in the form of goods and services. Work systems may be defined at any level from society as a whole to a work group at the department or subdepartment level of firms and organizations.

The notion of a work system as an input/output system is shown in Figure 1.

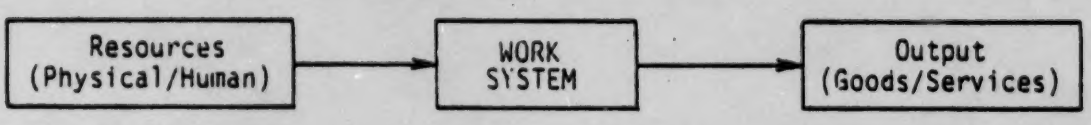


Figure 1. Input/Out Model

As indicated, inputs enter the work system, work in the form of energy expended is performed, and inputs are translated into outputs in the process. The process or rule for translating inputs into outputs is in the essence what is meant by technology. Thus, for any work system, the prevailing technology determines what outputs will be produced as a function of inputs. In the most general sense, technology can be regarded as an input/output function. Technology is not to be equated to either the inputs nor the output products of the work system. Rather, technology is the correspondence rule that determines the outputs resulting from a specific level of input.

Inputs into a work system are the resources used in the process of production. These resources in the most general sense are labor,



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capital, materials and energy which are frequently referred to as the factors of production. Output of a work system is measured in terms of goods and/or services produced. Using these definitions of input and output, technology can be regarded as the function that maps or transforms the factors of production into goods and/or services produced. In economic terms, this function is called a production function and expressed as:

Technology = Production function

= F(labor, capital, materials, energy)

Technology, considered as a production function, constrains the way the factors of production combine to produce an output of goods and/or services. For example, technology as process determines the unique contribution of each factor of production with the other factors held constant and determines the impact of substituting one factor for another. Factor substitution occurs when one factor such as capital is used in increasing amounts as a substitute for another factor, such as labor. The important point is that it is the current technology that determines how the factors are inter-related and the relative output contributions of each factor.

Suppose now that an increase in the output of the work system was observed even though all factors of production were held constant. The only way this could occur would be for the production function itself to change. Since technology is equated with the production func-

tion, this is defined as technological change. Technological change occurs when efficiencies in the production process allow for increased output without the necessity for more input resources to be used. Thus, if a change in output accrues from training workers to work smarter, but not harder, then a technological change can be said to occur, provided that the increase resulted from more output per unit of labor expended rather than more units of labor being expended (working harder). In a similar manner, technological change can result from any alteration in the production process that results in more output per unit of factors of production used.

Typically, technological changes result from the introduction of labor saving devices. These devices, in the form of equipment and/or tools, make it possible to glean increases in output per hour of labor input. The effect is to alter the production function so as to reflect the increased contribution of labor to production output. Technological change can also result from changes in the managerial and work structure that result in improved output contributions from one or more factors of production. Because of the multitude of sources, the technology of a work group is in a continual process of change. Thus, technology evolves through incremental changes as the work system seeks to fine tune the process through improved production efficiencies.

Periodically, conditions arise that substantially alter the organization of work systems. Responsiveness to these conditions requires that the work systems, to survive, must adopt a new production function. Production functions that differ in form are termed techno-



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logical innovations and are to be differentiated from technological changes. Whereas technological change is associated with incremental evolutionary changes in the production function, technological innovation signals a discrete shift from one form of production function to another. This discrete break with the past generally is associated with the introduction of a revolutionary new process that allows resource inputs to be combined in an unprecedented manner. One clear example was the introduction of the typewriter, increasing the speed (and legibility) of office communications. The impact of this and other significant inventions is to recombine the factors of production in a totally new and significantly more productive fashion. Thus, whereas technological change is evolutionary, technological innovation tends to be revolutionary in its effects.

## TECHNOLOGY AND PRODUCTIVITY

Productivity of a work system is typically defined as the ratio of system outputs to system inputs. Productivity increases when more outputs are produced per unit of input. Increased productivity makes possible an increased amount of goods and services per unit of factors of production used and results in an improved standard of living, increases in real income and strengthened price competitiveness. For an expanded discussion of productivity, see the companion project report "Working For America--A Worker-Centered Approach to Productivity Improvement" (CONSERVA, 1982).

The relation of technology and productivity flows from an examination of the definitions of the two concepts. Productivity of a work-

system can be defined for all factors of production used simultaneously, or each individual factor of production can be considered separately.

(a) Total Factor Productivity = $\frac{\text{Work System Output (goods/services)}}{\text{Total Resources Used (labor, capital, materials, energy)}}$

(b) Labor Productivity = $\frac{\text{Work System Output (goods/services)}}{\text{Labor Resources Used}}$

(c) Capital Productivity = $\frac{\text{Work System Output (goods/services)}}{\text{Capital Expended}}$

(d) Materials Productivity = $\frac{\text{Work System Output (goods/services)}}{\text{Materials Used}}$

(e) Energy Productivity = $\frac{\text{Used System Output (goods/services)}}{\text{Energy Consumed}}$

Recall that technology was defined as the production function F(labor, capital, materials, energy). Whereas technology is the function itself, a specific output corresponding to an input of L-units of labor, C-units of capital, M-units of materials, and E-units of energy is dictated by the technology and designated as f(L,C,M,E). By substituting for the output, the productivity definitions can be rewritten as:

(a) Total Factor Productivity = $\frac{f(L,C,M,E)}{L+C+M+E}$

(b) Labor Factor Productivity = $\frac{f(L,C,M,E)}{L}$

(c) Capital Productivity = $\frac{f(L,C,M,E)}{C}$

(d) Materials Productivity = $\frac{f(L,C,M,E)}{M}$

(e) Energy Productivity = $\frac{f(L,C,M,E)}{E}$

Technological change influences the productivity of all factors of production by altering the value of the production function f(L,C,M,E). If the change in technology results in a positive increase, then productivity will also increase accordingly. The explanation is that technological change makes possible increased outputs of goods and services without a corresponding increase in resources used. This increase in the stock of goods and services available is translated into an increase in the standard of living as more wealth is available for distribution. An expanded standard of living creates demand for additional products and services which provides work for more people. Additionally, increased productivity allows goods and services to be priced more competitively since increased productivity lowers per unit production costs. Price stability is beneficial in that it is anti-inflationary and contributes to our ability to compete on the international market.

TECHNOLOGY AND WORK

Technology is the great arbitrator of work. It is technology that specifies how capital goods can be used by workers to convert raw materials into finished products. It is technology that determines the range of human skills and abilities necessary to use the capital goods as production tools. It is technology that specifies the appropriate materials for which the tools can be used and the energy required for their use.

Whereas technology sets the stage and writes the script, it is management that directs the production. Management's decisions determine the desired mix of labor and capital, the rates at which labor

and capital will be utilized, the quantity of labor, capital and materials used and the extent of substitutability between elements of labor, capital and energy. It is also management's responsibility to maintain a management climate that facilitates the most efficient and coordinated use of labor and capital. For a discussion of the impact of management climate on productivity and suggested strategies for development of a worker-centered approach to productivity, see the companion project report "Working for America--A Worker-Centered Approach to Productivity Improvement," Chapter III, (CONSERVA, op. cit).

Innovations incorporated in new capital goods tend to spearhead technological change and innovation. The latest advances in knowledge and theory tend to be embodied in the design and structure of new capital equipment. Innovations and capital goods design have direct implications for labor as a factor of production.

These implications affect not only the human skills requirements, but also the very organization of work itself. Human skills requirements may be relatively unchanged in those cases where new advancements were made without basically altering the production process. A typical example might be the interchangeable type ball typewriter system. In this case, the advancement could be basically incorporated into the existing process and would require minor alterations in human skills requirements. Contrast now the introduction of intelligent typewriters that can "remember" and alter pages of text, culminating most recently in highly sophisticated word processing systems. In this example, the very organization of work itself has been drastically



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changed with consequent changes in the nature and intensity of human skills requirements. This represents a dramatic illustration of the distinction to be drawn between technological change and technological innovation.

The press for technological innovation is strong and mounting in intensity. Productivity growth is sagging in the country, having fallen from an average annual rate of increase 3.1 percent in the period 1948-58 to a mere 0.7 percent for the period 1974-81. (Statement of the Chamber of Commerce of the United States on Productivity, April 2, 1982). There is near universal agreement that the lack of capital has been one of the major causes of this decline. As Lester Thurow, a noted expert on productivity, states,

> The amount of equipment per worker--the capital-labor ratio--is a key ingredient in productivity growth. Better-equipped workers can produce more output per hour, but new capital is also a carrier of new technologies. To put new, more productive technologies to work, workers must be provided with the equipment that embodies those new technologies. Without this additional hardware, or "physical capital," it is impossible to translate new knowledges into new output (Technology Review, November/December 1980, page 45).

In the area of foreign trade, the United States is in the process of moving from being a net exporter to a net importer in major categories of industrial output. As shown by a study recently conducted by the Department of Labor, of the top 17 U.S. export commodities, losses in the world market were experienced in 14 of the commodities. Between 1962 and 1979, the U.S. trade position had deteriorated such that market losses had been experienced in all 17 of the top export commodities. (Congressional Hearings, December 1980 and January 1981).

The report attributed the decline in U.S. international competitiveness to changing supplies of world resources and diminished technological capabilities. The rate of growth of the capital-labor ratio, a measure of the amount of capital available per worker, declined to such an extent that the United States fell from first to sixth in terms of capital available per worker. The United States' share of world capital fell from 42 percent in 1963 to 33 percent in 1975. During the same time, Japan doubled its capital from 7 to 15 percent of the world's share. As the U.S. stock of physical capital fell, so did its human capital. According to Department of Labor analyses, the United States fell from second to seventh in terms of percentage of skilled workers in the labor force-with the U.S. share of skilled workers falling from 29 percent to 26 percent. (Congressional Hearings, December 1980 and January 1981, op. cit.).

As a compounding problem, the United States is reported to be experiencing a severe shortage in skilled labor. In a widely quoted report, the Department of Labor projects average annual training shortfalls in excess of 250,000 persons per year for the next decade (U.S. Department of Labor, 1980). These are regarded as minimum estimates since they result from inclusion of only the 13 occupations with the greatest projected shortages. The Task Force on the Skilled Trade Shortages, which represents a coalition of 13 metalworking industries, estimates an anticipated need for 240,000 journeyworkers in the metal trades by 1985. (America's Skilled Trade Shortage: A Positive Response, 1981). The American Electronics Association, in a survey of its members, projects a need over the next five years for approximately 113,000 technical professionals in eight job categories and an addi-



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tional 140,000 technical paraprofessionals in 13 job categories. (Shortages in Skilled Labor, November 3, 1981).

America stands at an economic crossroad. In the face of impending labor shortages, American business and industry can follow one of two major courses--one will be business as usual. If that philosophy prevails and a labor shortage materializes, per unit labor costs can be expected to increase, leading to increased prices as businesses seek to maintain their profit picture. Continued sluggishness in capital investments, coupled with the shortage of skilled labor, will dim any prospects for productivity improvements. As a result, inflation can be expected to escalate, our standard of living to diminish, our foreign competition to increase, and the United States will be well on its way to becoming a second-rate power.

As an alternative, the United States can make a significant investment in labor-saving capital in an effort to reverse the productivity trends and to regain the competitive edge. If the strategy is undertaken with vigor, the implications can be profound. Unlike the early '60s when the concern for the effects for technology proved to be unfounded, the United States currently stands on the brink of a technological revolution drawing its force from the emergence of the microprocessor and its ubiquitous applications. Word processing, electronic mail, graphics design, facsimile production, and so many other functions of the modern office are made possible or greatly enhanced by digital microelectronics.

America is rapidly shifting from a manufacturing to a service-based economy. In 1950, nearly one out of three non-agricultural work-



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ers was employed in manufacturing, and only one out of eight employed in services. By 1980, only 22 percent of the non-agricultural work force was in manufacturing as opposed to nearly 20 percent in services. In terms of percent change in employment for the three decade period, manufacturing increased a scant 33 percent in contrast with a 231 percent increase for services (Impact of Technological Change, 1981). The shift is being experienced both in international as well as domestic markets. While we are becoming a large net importer of manufactured goods, the United States now exports about $60 billion worth of services a year. This qualifies the United States as the largest exporter of services in the world, exporting nearly 25 percent of the world's service base. (Presentation of Dr. David L. Birch to the Council of Upper Great Lakes Governors, March 5, 1982). As a consequence of our changing service base, capital investments to facilitate handling and communication of office information can be expected to increase. New capital innovations can be anticipated in the areas of advanced word processors, electronic methods of reproduction and transmission of images and other electronically-augmented telecommunication devices.

The impending technological revolution will not be expected to be entirely bloodless. The transition from a manufacturing to a service economy can be expected to have severe short-run implications for those whose skills have become obsolete because of changes in technological demands. Whereas job displacements may be regarded as but minor perturbations in society's overall growth, they represent crises of major proportion in the lives of those who are experiencing them. In order to ease the transition and to contribute to the more effective and best productive use of our human resources, it is incumbent that quality



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skills training be provided that is attuned to the demands of emerging technology needs and available to all those who can profit from its exposure. The extent to which vocational education rises to meet these needs will determine the contribution that vocational education makes to the revitalization of the economy and the continued prosperity of society.

# CHAPTER II

## NEW AND EMERGING TECHNOLOGIES

Vocational education to be responsive to the demands of forthcoming technology must become increasingly aware of the nature of these technologies and their associated training requirements. In recognition of this need, CONSERVA, Inc. was awarded a contract by the U. S. Department of Education to identify the most innovative, new or changing technologies and to assess their occupational implications for specific vocational education program areas. The procedures used to identify and clarify technologies are presented in the first section. Brief descriptions of the identified technologies are included in the second section. Cameo reports describing the major new and emerging technologies with implications for Office occupations are provided in the third section.

### IDENTIFICATION AND SELECTION PROCEDURES

In order to identify new or changing technologies with implications for vocational education, project staff reviewed recent years' issues of several hundred different business, trade/industrial, and technical periodicals seeking information concerning technological change or its impact.

In reviewing published articles for possible relevance, three basic characteristics were considered. First, there must have been evidence that the technology is currently being used in the "real world"--i.e., that it is not still "on the drawing board" or futuristic. Second, the technology must have appeared to have direct or indirect

implications for the way work is performed, and must impact skills within the training domain of vocational education. Finally, trend projections or other indications were sought as evidence that the technology was being increasingly used, implying greater numbers of jobs affected and resulting importance to vocational educational programming.

Having identified a set of technologies which are new or emerging, which promise growth, and which appear to impact job training, project efforts focused on the possible vocational implications of the technology. The implications were defined in terms of job activities affected, knowledges and skills required to carry forward these job activities, and special equipment or facilities (cost considerations) which might be necessary to instruct vocational students in the technology.

As a means of obtaining technology-specific information, outside experts were sought whose backgrounds and performance records qualified them to speak with authority about specific technologies and their training implications. For each of the identified technologies within a specified vocational education program area, a knowledgeable individual was invited to author a brief, nontechnical essay oriented to vocational education.

Since certain technologies have rather broad occupational implications, authors were allowed discretion as to which occupations or tasks they would emphasize. In making their decisions, authors were requested to consider the developing technology from a training and instructional perspective. Specifically, authors were asked to address the following areas:

- Work activities which involve the technology --

  The kinds of major duties or activities that may be new, changing, or developing as a result of the new or changing technology, with reference to the occupations under discussion.

- Knowledges and skills essential or important for productive completion of such activities --

  Knowledges are awareness of facts and process details, understanding of principles, etc., and "skills" are "hands on" abilities actually to carry out functions. The knowledges and skills to be covered were to relate to the work activity demands of the new or developing technology.

- Special equipment or facilities that would be required to teach such knowledges and skills --

  Aside from books, other usual instructional media, and standard educational facilities, any special devices (e.g., simulators or prototypes) or other capital that might be needed for instruction in identified knowledges or skills.

- Growth and trends in the diffusion or expansion of the technology --

  Observations of recent growth, and projections concerning likely near future expansion, of the technological innovations or changes, in business/industry/other applications that involve occupations under discussion.

## TECHNOLOGIES EXPECTED TO IMPACT OFFICE OCCUPATIONS

Technologies selected for inclusion are those determined by application of the criteria to have programmatic implications for Office occupations. Brief descriptions are presented below. The purpose of these descriptions is to generally and summarily define the technologies being discussed by the experts.

Microcomputers or Personal Computers, also called "desktop" computers, are by now somewhat familiar to us all. Small-sized and affordable by comparative standards ($5,000 or less will buy a sophisticated system), these machines incorporate many of the logical capabilities of larger computers and can be programmed to perform many of the same sorts of tasks. This is made possible by microprocessor technology. Microprocessors, based on large and very large scale integrated circuits, have sometimes been called "computers-on-a-chip." Microprocessors are used not only in microcomputers but in many other "hardware" systems which can then perform computer-like functions.

Database Systems are computer systems and programs which help organize, update and transmit information, particularly selected subsets of information culled from a much larger set called a database. Databases often contain a large number of "records" which are similar in structure but different in specifics. For example, a record may contain a person's name, age, height, weight, and so forth. If a database is formed from such records, the database system may be used to retrieve all or part of this information for a given individual, to list the names of all individuals within a specified age range, to change or update records, etc. The master computer program which facilitates these information transactions to take place is called a database management system (DBMS). When information is handled over long distances in coordinated fashion (such as in confirming an airline reservation or in using a bank's teller machine), the process may be referred to as distributed data processing (DDP).



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The concept of Software is not new, but advanced computer technologies and increasingly sophisticated computer applications have caused software technology to develop and change accordingly. Software refers generally to the computer programs which direct the machine to perform specific tasks. New programming "languages" and techniques, and the development and use of new and important general or special-purpose computer programs, constitute the areas of interest in software technology. The term "software engineering" has come into use in recent years to describe systematic approaches to computer program development.

Optical Data Transmission is a technology which is made possible by advancements in fiber optics--the transmission of light through transparent fiber cables. Light from a point source (normally, a low power laser) can be used to send the intelligible messages by optical, rather than electrical, impulses. Transmission of such signals over optic cable can have some advantages over electrical wire transmission.

Worker Participation in Management refers to organizational structures and functions which involve vocational workers in efforts to improve production or quality. These "soft" technologies include quality control (QC) circles, an important new development, as well as quality of work life groups and some methods of organization development.

Inventory Control Systems are technologies which facilitate the efficient and cost-effective movement of supplies and products to and from warehouses associated with sales or manufacturing firms. Computer technology and related advancements have made possible not only automated retrieval and reordering (e.g., through product numbering and scanning), but also more sophisticated methods of paring down inven-

tories to the amounts needed and the better utilization of computational methods for controlling other inventory costs.

Office Automation involves the broadening use of computer technology in the office environment. Office automation, however, is not simply the use of computer technology to support office work. Rather, it includes the proliferation of computer-based work stations throughout the office and at all levels from clerk to executive. In addition to the now prevalent word processing functions, electronic mail and filing, data storage and retrieval, "personal" computing including graphics capabilities and interactive on-line communication and data sharing systems are some of the elements of the Office of the Future.

Word Processing involves the application of computer technology to the typewriting or keyboarding process. It is sometimes described as the key to office automation and is used in the development, production and revision of such materials as long documents, reports, form letters, memos, mailing labels and lists, and other correspondence. Other functions can include calendaring, timekeeping and billing operations. Information entered into a word processing system can easily be edited, revised, re-formatted, changed by deletion or insertion of data and generally polished into a better final product without rekeyboarding the entire document.

Alternative methods and practices of Work Scheduling are changing the ways and the places of work. A number of new approaches are being tried in business and industry to adapt to the needs of both the employer and the employee. Job-sharing, "flexitime," work at home, in satellite centers or in other locations are some of the alternative working arrangements being used.



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TECHNOLOGY ESSAYS

The following essays describe the new and emerging technologies identified as impacting Office occupations. The essays, while edited for consistency, remain basically the products of their authors. Sincere appreciation is expressed to the following experts who have so generously contributed of their time and expertise:

JEFFREY C. HECHT, B.S.E.E., M.Ed., is a consultant and writer specializing in physical science and technology. Formerly managing editor of Laser Focus, his articles on technological advances have appeared in a number of popular science magazines. President of Futuretech, a young consulting firm, Mr. Hecht has chaired and moderated symposia on laser technology and on computer networks, and holds professional memberships in a number of technical associations including the American Physical Society and the Optical Society of America.

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# "PERSONAL" COMPUTERS IN THE OFFICE

by
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Historically, advances in office productivity have lagged behind productivity growth in other areas. Thanks, however, to advances in microelectronics during the last few years, office technology is now taking a quantum leap forward in productive capability. In the vanguard of this revolution is microcomputer technology--with which office workers will need to become as proficient as with typewriters and calculators.

## What Are Personal Computers?

Microcomputers, or "personal" computers, are desktop, portable, general purpose machines controlled by software programs that work with various peripheral equipment, such as printers, plotters, telecommunications devices, and data storage systems. Personal computers may have smaller memories and less sheer computational speed than large "mainframe" computers, but they are easier to use and far less expensive to purchase, operate, and maintain. These qualities make them ideal for use by individuals and small businesses.

Moreover, great improvements have been achieved in what used to be the single most limiting factor about using personal computers--the amount of data storage that can be kept "on-line" and readily accessible. In the past two years, various companies have offered suitcase-sized mass storage systems for personal computers that use sophisticated hard disk technology to let users search through, sort, file, and mani-



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pulate--often just in seconds--40 million characters of data or more. That's enough to fill completely over 14,000 single-spaced pages, or at least three four-drawer filing cabinets!

Indeed, it is probably safe to say that during the next ten years no technology will be changing the way people work in offices as much as personal computers will. Virtually every type of work activity will be affected, and a number of new or developing uses of computers will become commonplace.

Changing Office Routines

Filing, scheduling, bookkeeping, communications, training, document preparation, and mail list management are all office activities that will change as the result of using personal computers. Modeling (forecasting) and graphics production are two developing activities that heretofore weren't done by office personnel. Many of these activities are linked.

For example, personal computers make it possible to draw on information previously stored on hard or floppy disks to reschedule a multi-stage project, using a scheduling program. The new schedule can then be inserted into a memo written with a word processing program, and mailed to a list of people maintained by a mail list management program. Or if time is of the essence, the memo can be sent--"instantaneously," electronically--over ordinary phone lines to branch offices all over the world.

Many medium-sized firms now use large computers or computer services to keep track of accounting data. Small offices, however, haven't



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always been able to afford it--and many businesses, large and small, would like to get greater personal control over their bookkeeping without actually having to hire their own computer programmers. It's now possible, using personal computers and easy-to-use accounting programs for general ledger, payroll, inventory, job costing, accounts receivable, and accounts payable.

The production of business graphics is another good example of new office activities that are developing as a result of the introduction of personal computers. To create a 35mm slide for a business presentation usually requires the use of outside suppliers, normally takes a week or longer, and may cost $35 to $50 or more. Now, however, personal computers are making it possible for office personnel to prepare audio-visual materials. The user instructs the computer with English-like commands how to "draw" the bar or pie chart desired. Results are then sent electronically over ordinary phone lines to an outside service, which uses them to create the final slide in seconds--for under $10. Total turnaround time could be as little as two days.

Even faster will be the ability to use a variety of type fonts (including boldfaced, italicized, and custom-designed ones) within the same document, and the ability to create charts, graphs, drawings, and other graphics for insertion into the middle of reports and documents. As early as 1983 personal computers with sophisticated graphics "editors" will be making it relatively easy for people without any artistic skills to "compose"--quickly and cheaply--printed office communications displaying much the same kind of imagination and impact that professional graphics designers take weeks to achieve in costly brochures.


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Following the introduction of the typewriter in the 19th century, handwriting important letters and documents lost its respectability. In much the same way, most printed communications in the 1980s and 1990s will look drab and unimaginative if they fail to incorporate at least some of the powerful graphics capabilities of personal computers.

New Essential Skills and Knowledges

The first personal computers were most suited for use by the programmers and engineers who usually bought them. But as more people without technical knowledge obtained personal computers for text editing and other paperwork applications, the complexity of the application program, not the computer itself, became the determining factor in how long it took to become proficient in a particular task. Most models currently available require little more than a knowledge of the keyboard--which is very similar to a modern office typewriter's--and some practice using special function keys that position you in the text and perform other preprogrammed functions.

Today's personal computers use carefully constructed application programs that don't assume any previous computer experience on the part of the user. They're designed to be "user friendly"--that is, easy to learn and use. It's possible to start using an electronic spreadsheet, for example, by spending an hour or two working through an interactive tutorial program. By 1984 a new generation of personal computers--with fast interactive graphics, memories two to four times the standard size of today's, and other features that enhance learning will cut basic training time to a few minutes.



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However, as with most skills, proficiency is largely determined by experience. Those people who have hands-on experience with basic application programs such as electronic spreadsheets, word processors, electronic mail, business graphics, filing systems, and others, will find it easier to learn additional programs or new versions of standard programs. Resumes are already beginning to reflect this fact, noting not only experience with particular computers, but with particular application programs as well.

New Training Environments

Personal computers, accessories, and programs are relatively expensive to purchase and maintain. Schools and other organizations that intend to train whole classes of people at a time will find it necessary to dedicate rooms or buildings for use as computer training laboratories, in order to maximize efficient use of equipment and programs. Also, where learning stations are in close proximity to each other, it's possible to network systems and share expensive printer and storage facilities.

The minimum requirement for each learning station would be the personal computer itself, a storage system (usually a floppy disk drive with controller), and a video display monitor. In addition, networking systems and mass storage hard-disk drives--they can cost $10,000 or more--can result in greater speed and flexibility for the entire system, computer operators and teachers alike. With a networked classroom, for example, students can share programs and data taken off a central disk, and store answers, grades, attendance information, and other data, all "locally" on the floppy disk drives of the individual learning stations.

New versions of computer programming languages like PILOT are allowing teachers and trainers to "author" sophisticated training programs that work with videotape recorders and videodisks. The large number of images that can be stored in video medium (in still or moving-frame form) and then accessed by programs running on the computer, are creating a whole new field of interactive training and computer-assisted instruction possibilities.

Future Growth and Trends

In 1981, one million personal computers were sold--more than all those ever sold to that point. This amounted to a $2.2 billion market. By 1985, if projections hold, the personal computer market will be $8-10 billion in size, with more than four million units being shipped annually. Most offices will have one or more systems, and find them indispensable.

These projections assume some important market changes, however. In particular, using computers will have to continue getting easier; prices will need to continue dropping relative to other costs; and more efficient systems of retail distribution and servicing will need to be put in place.

In terms of the office, these projections imply equally important changes. Typewriters may virtually disappear from office environments, where their noise and mechanical inefficiencies will be relegated to odd chores like addressing oversized envelopes or filling in non-standard forms. Instead, office personnel will use personal computers to accomplish a wide range of new tasks, like creating forecasts and sending electronic mail and creating presentation graphics.



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Less time will be lost unproductively to repetitive tasks, like retyping an entire report to plug in changes; more time will be spent planning, making decisions, communicating, and performing other principally management-oriented functions. The result will effectively be a general upgrading of many jobs, and an increase in responsibility for many office personnel.

# DATABASE SYSTEMS IN THE OFFICE

by
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Computers have slowly but surely begun to invade the office in recent years. Up to now, this invasion has occurred in the form of computerization of individual office machines. For example, computerizing the typewriter results in the word processor, computerizing the adding machine results in the electronic calculator, and so forth.

The trend that is emerging now and will accelerate in the next few years is that of integrating the various "intelligent" machines found in the office. The focus of this integration will be the introduction and application of database systems and computer networks to the office. This will allow the office data to be stored, manipulated, and retrieved electronically by many different office workers more efficiently and effectively. The integration of office machines will also allow some activities, such as the transcription of data between different media, to be eliminated. Three areas of office work will be profoundly affected: data entry and management, office communication, and office procedures.

## DATA ENTRY AND MANAGEMENT

Office data are of many different types: letters, reports, forms, etc. More and more of these documents are being created, stored, and transmitted electronically. Computer-based document entry and management will change the nature of the jobs of such office workers as



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general typists, file clerks, office machine operators, messengers, secretaries, administrative assistants and office supervisors/managers.

More emphasis will be placed on the management and communication of documents such as letters and reports, and less on the data entry itself. Typists will still be required to input documents and for major revisions. However, administrative assistants and managers will be able to easily access their documents electronically, make minor revisions, and transmit the documents instantly within the organization. The task of preparing, filing, correcting, and transmitting documents will become integrated through the database.

For documents such as repetitive forms, more forms-based office systems will emerge. Thus, rather than capturing information on paper for subsequent data entry, it will be captured immediately, electronically for storage in the database. Office systems will interface as front-ends to traditional data processing systems.

Users of office systems will need to be able to devise and/or use computer-based schemes for managing documents. They will need to know how to create, store, manipulate, and transmit documents electronically. Since documents will be in electronic form, it will become fairly easy to use "cut and paste" techniques for creating and editing documents. Users will need to know what information is available electronically, how to access it, and how to use it effectively. Ad hoc document management and communication schemes will not work effectively in a computer-based office environment.



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OFFICE COMMUNICATION

Office communication can take several forms: telephone, postal mail, recorded messages, face-to-face conversation, etc. More and more office communication will become computer-based with the communication retained in a database for future reference and/or processing. This affects the jobs of correspondence and mail clerks, phone operators, PBX/PABX operators, messengers, secretaries, and managers.

Eventually, almost all internal office communication will be done electronically rather than on paper. Text, voice, graphics, and image data will all be stored and transmitted electronically. Internal paper mail services can eventually be eliminated. Voice message systems will eliminate the need for many telephone operators as messages can be left electronically. Most other office communication tasks that require a human intermediary will also be eliminated.

Voice message systems may possibly result in more dictation of external correspondence. Thus the skill to be able to transcribe documents from voice will be needed. Electronic messages and documents will need to be much more brief and concise since there is a tremendous capability to create many more messages more easily. Abstraction and creative abilities will be required in order to construct electronic messages that people will read. Good written and verbal skills will be needed. Interpersonal skills may not be so important in such a communication environment.



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## OFFICE PROCEDURES

The types of procedures performed by office workers range from those that are well-structured to those that are unstructured. Procedures that are well-structured and well-understood, such as accounting, billing, etc., will become more and more automated. This will affect the jobs of accountants, bookkeepers, file clerks, administrative assistants, shippers, and receivers.

One approach that can be taken to procedure automation is to allow the users who understand the procedures to "program" the procedure into the computer. These procedures will interact with each other and with the database where the data required to perform the procedure is stored. In most cases, these procedures will be able to run without human intervention.

Users of such systems will need to have some understanding of the functioning of computer processing. In addition, they will need to understand their work process and be able to express the procedures they follow logically in terms of paper and/or information flow. New work processes may need to be created to take advantage of the computer system. Some analysis of procedures to determine their effectiveness may be required. The automation of the routine aspects of a task will leave the person that performs that task free to concentrate on the handling of exceptional conditions that arise. Thus, decision-making skills will be much more heavily emphasized in such an environment.

SUMMARY

Office work is becoming more and more computer-based with data base and communication technology at the center of such systems. The computer room in an organization will still be required for traditional data processing applications. Office systems will interface with these applications by acting as a front-end for the capture of data. The end user of database technology will be the modern office worker.

In order to train people to work in such an environment, it will be important to provide them with some fundamental understanding of the tool they will be using, namely, the computer. This understanding need not be at any more detailed a level than that which most people have about how a car works. Then, they will need to be taught to apply their written and verbal communication skills and their analytic skills in a computer-based work environment. Finally, it will be necessary to provide some hands-on exposure to the computer technology that will be used in the office.

Creative skills in the office will become much more important. People who understand work flows, who have analytic skills and can codify a task, and those who are able to handle exceptional conditions will be in high demand. In such a computer-based office environment, the office workers will be able to devote their skills and training to the challenging, problem-solving tasks in the office and to leave the mundane, repetitive tasks to the computer.



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# SOFTWARE BREAKTHROUGHS AND OFFICE OCCUPATIONS

by
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Due to the drop in computer hardware prices, the computer is moving more and more into the office environment. Since the lower hardware prices also allow much more sophisticated software, the use of the computer by non-programmers is becoming increasingly common. Several software innovations have made this trend practical. In turn, successful software is now expected to have many of the new features.

While there is no one software innovation that stands out, the new faster, cheaper hardware has allowed much more attention to be paid to the user interface. Features like "Menu-Drive" programs, extensive "Help" features, and user-friendly prompts all have made the use of computers in the office feasible. Increasing use of graphics is making programs more effective and easier to understand.

All of these trends will increase the productivity of the office worker. Here we are talking mainly of the "consumers" or users of software, not the business application programmers and the like who are producers of software.

Since computers and the necessary related hardware is now available in the office, this places the burden on the office worker to make use of it. For educators this means that the education of the future secretary, clerk, or administrative assistant must include exposure to the various computer systems that an employer would expect them to use. While the burden is on the producer of the software to write programs



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for use by the non-programmer, nonetheless, there is much that office personnel can learn to speed their becoming effective users of these products. Increased understanding by office workers of the way computer systems work will increase productivity and will decrease potential frustration and alienation when problems occur.

## WORK ACTIVITIES WHICH INVOLVE THE TECHNOLOGY

The most common way that office workers will be involved in using modern computer software is in entering some kind of information into a computer system. For the secretary this may mean using a word processing system, entering various production, sales, or other fiscal data. For the clerk, it might mean updating mailing lists and other files. For the administrative assistant this might involve various payroll, budgetary, and planning data. If the software is good, and the personnel have appropriate understanding of the computer systems involved, this will be an improved experience over previous manual procedures.

Retrieval of information from these software systems is, of course, the other side of the use of these systems. Intelligent retrieval, making optimal use of the computer systems is something all office employees will be exposed to, but will be more often performed by the high level employees, such as the administrative assistants. For example, the computer might be used to project spending in various budgets. This forecast would be based on information entered by all levels of employees but would only be called for by the more senior level office workers.



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KNOWLEDGE AND SKILLS

Each of the successful modern software packages will be different and have its own set of rules and documentation. The best packages will provide all kinds of aids to the user to make the learning as painless as possible. The educator should try to give students exposure to representative software packages and try to give them some understanding of computer sciences.

Building a systems vocabulary so that terms like "files," "records," "disks," etc., are not strange to the student is extremely important. Part of the educational process should involve taking the "magic" out of computers and reducing the fear of machines. Students should understand that they can't break anything by pushing the wrong key, but that they can lose a lot of previous labor if the procedures aren't planned carefully.

Sample systems might include word processing systems, spread sheet analysis programs such as VisiCalc (TM) and exposure to simple database management systems. Disks, tapes, and file systems should be topics covered, and processes like back-up, and update should be included in the course. Ideally both central, time-sharing systems and personal computer systems should be available for demonstrations.

SPECIAL EQUIPMENT AND FACILITIES

The major reason for capital equipment is for demonstrating the various software systems that the students are to be exposed to. While most of these packages can be used on remote computers through time-sharing terminals, the trend is to have personal computers and special



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office equipment. Both local and shared equipment should be available. Only the demonstration of a data base management system would require a remote-shared computer.

Word processing could be demonstrated on dedicated, special purpose systems, but can also be illustrated using editors on a time-sharing system. Personal computers also support excellent word processing systems. Again, since it is unlikely that educators will be able to expose the student to the exact system that he or she will encounter after school, it is the variety of systems and software products that is important.

GROWTH AND TRENDS

It is clear that automation will be more and more important in the office as new and better software is developed. The products will be easier to use as programmers develop the techniques and skills needed to provide a friendly user interface. Computer aided instruction (CAI) will be available to supplement the built-in learning aids. Office workers will be expected to fully utilize these new products and to increase their productivity accordingly.

There will also be a trend for management to become directly involved in using this software and the lower level clerical personnel will be by-passed altogether. Thus, there will be fewer but more productive support persons for each person in management.



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# INVENTORY CONTROL SYSTEMS AND OFFICE WORKERS

by
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Inventory control systems in the 1980's will no doubt be subject to the same forces that have so drastically altered the field in the recent past. These forces, namely high interest rates and the resultant high cost of inventory, demand for ever-changing product configurations, and decreasing data processing costs, have altered optimum inventory/ordering strategies.

Most forecasters predict high interest rates for the 1980's as a result of deficit spending by both the public and private sectors now taking place. In the past, inventory was ordered to maintain an on-hand quantity to assure meeting future needs. "Reorder point" strategies were implemented to replenish stock when inventory fell below prescribed volumes. While still in use, this approach to inventory creates unallocated material in pre-process inventories. With the higher cost of money, industries turned to a discrete ordering of materials, purchasing only those items that were needed and having them delivered just at the time they were needed. This concept was applied to "in-house" items as well, using materials acquisition scheme called MRP, for Materials Requirement Planning.

MRP-type systems came into use only within the last several years, made possible by the powerful computer systems newly available to smaller businesses. Such systems consist of software programs to help schedule materials requirements against both quantity and time period of actual manufacturing need. So pre-process inventories decrease; how-



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ever, any materials shortage, lateness, or damage seriously affects the shipment or the entire work-in-process. Capacity planning was incorporated in the second stage of MRP systems to address the more critical scheduling function. But as of 1980, only 34% of all users of MRP had this essential capacity planning function for equipment, and only 9% of the users had the resource planning which included labor requirements. Only a fraction of manufacturing companies have an MRP-type system at all.

A second dynamic force on the inventory system, apart from the cost of inventory, is the need to implement new technology and product configurations quickly for competitive reasons. Increased foreign competition has exacerbated this problem. It is not common to have new products introduced several times a year or to accommodate the customer's special design requirements. All of this means that unallocated inventory may never be used and have to be "written off" as a loss to profit. The answer to this problem again was to order only the material needed. Fortunately by 1980, the cost of data processing hardware had decreased to one-tenth of its 1970 cost, permitting more companies to handle the increased data requirements of discrete ordering (and delivery) and capacity planning.

While there are several office-related functions that will experience change, the most profound will be to that of the production planner. There are numerous planning techniques that have been developed by academic experts, many of which have been reduced to simple algorithms. Still, little has been done to provide others (i.e., production planners) with these relatively simple techniques. The gap be-



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tween academia and industry is understandable. Those teaching these techniques have had limited audiences, usually at the predoctoral level. The production planning vocation has been largely ignored by vocational learning institutions. Yet working planners may have only high school or trade school education. They may be unfamiliar with available technology.

One set of techniques, like MRP, concerns the determination of how much to order, and falls under the rubric of "lot sizing." Very generally, lot sizing involves cost minimization when both costs of inventory and costs of ordering are considered. The more ordered at one time, the greater the inventory costs but the less the ordering costs per item. Several factors, including interest rates and anticipated demand, contribute to the computation of minimum joint order/inventory costs. Especially with the advent of small business computers, but even without this computational assistance, productive use of most appropriate lot sizing techniques is within the potential capability of managers and planners with knowledge of elementary algebra, and they should be more widely taught in vocational curricula. While many useful models are available, few companies including the largest have been made aware of these techniques. For example, the materials manager of a giant telephone equipment producer, employing 10,000 people at his location, knew only one lot sizing model.

Some forecasters for the 1980's foresee interest rates as high as 40%. Few predict interest rates below 10%. Inventory control for manufacturers including small businesses is essential for their prosperity. The technology is available today to permit rapid employment of

these controls. Though the prospects for more widespread use of MRP-type systems remains uncertain due to the problems noted above, managers and planners should be aware of the philosophy, potential benefits, and difficulties involved with such systems, and how they are implemented. Perhaps more importantly, those concerned with controlling the costs of ordering and inventory should be taught principles and various methods of lot sizing.

Aside from the new planning and scheduling techniques, many of the activities will remain as they are today, and can in principle be accomplished by office personnel in the production planning role, if they are properly prepared.

Specific activities of production planners will include:

- Scheduling new work orders in accordance with available material and capacity;
- Reviewing on-hand finished goods inventory;
- Data input into the on-line computer;
- Generating new production plans;
- Coordinating various manufacturing activities;
- Expediting materials and work orders; and
- Selecting the most appropriate planning and scheduling techniques.

The skills and knowledges needed to support these activities include:

- In-depth knowledge of various planning and scheduling techniques;
- Working knowledge of the product structure;
- Knowledge of production alternatives; and



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- Data processing input and retrieval capability.

The basic equipment required for teaching production planning will include a direct access terminal or dedicated microcomputer, and computer programs simulating the loading in a manufacturing facility, and providing formula-based computational assistance.

# WORD PROCESSING

by
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Word processing involves the application of computer technology to the typewriting or keyboarding process. Word processing is frequently described as the key to office automation because it is the point of input. Keystrokes are captured and stored for many uses involving a variety of office systems. Once information is put into a system through word processing it is available for future use without the time-consuming process of rekeyboarding.

Information to be keyboarded is acquired in a variety of ways, such as from longhand rough draft materials, previously typewritten copy, and machine dictation. Word processing specialists generally are responsible for keyboarding and storing text rather than numerical data, although information consisting of both text and data may be involved. Word processing specialists are also responsible for inputting information in the proper format or in such a manner that it may be retrieved and proper formatting applied as required later for a specific use.

Word processing is most frequently used for long documents and reports, repetitive letters, memos, and correspondence. It is very helpful to capture the information as it is created for reports, manuals, and directories. Once it is captured it can be edited and revised and generally polished into a better final product without rekeyboarding the whole document. Corrections and changes are made much more easily and quickly with word processing and additional errors do not occur in the unchanged material since rekeyboarding is unnecessary.



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Form letters may be stored for later repetitive playback. They may be personalized with an individual's name and address and other required variables. Paragraphs may be stored to be retrieved, combined, and assembled in different formats for use in legal documents, medical reports, technical specifications, and in correspondence.

Advanced text editing functions may involve use of global search/replace as well as automatic repagination and footnoting and phrase and format storage for efficiency. Advanced word or text processing applications include entry to computer storage and electronic files, transmission of electronic mail via computers or communicating word processors, and entry or interfacing with phototypesetting equipment to eliminate the need for rekeyboarding of material to be printed. Other advanced word processing activities depend on creation of data bases of information from which word processing specialists may also be called on to perform sorting and selective retrieval operations. Some word processing specialists may also make use of technology to perform calendaring, timekeeping, and billing operations in the offices of professionals such as lawyers, doctors, and accountants.

Certain knowledges are essential for a word processing specialist to be most productive. These include:

- An understanding of information flow and the information cycle.
- An understanding of computer technology and how the computer (word processor) can be used to process information effectively and to perform many tasks more efficiently.
- A conceptual understanding of the use of a database and an understanding of electronic files and how to store information for retrieval and future use.

Certain skills or abilities in relation to use of equipment are also necessary. These include:

- Keyboarding or typing skill--ability to type 40-80 words a minute accurately as well as possess statistical typing ability.
- Formatting skills--the ability to organize and handle creatively the formatting (setting up) of various kinds of documents, such as letters, reports, lists, handbooks, brochures, manuals, speeches, newsletters, presentations, legal documents, financial statements. This would include facility with inserting, deleting, and moving blocks of information.
- Editing and application of language or verbal skills--including vocabulary, spelling, grammar, and knowledge of punctuation.
- Proofreading skills--the ability to find errors in both "type" and content.
- Transcription skills--to be able to use a machine transcriber and to transcribe from dictated material with a high degree of accuracy and efficiency.

To teach students to perform word processing effectively, some form of terminal or electronic workstation is necessary. A keyboard for input and some kind of intelligence and built-in memory to permit storing information for reuse is required to develop needed knowledges and skills. Requisite equipment might include electronic typewriters with memory, microcomputers, specialized word processing equipment, and/or terminals tied to a mainframe computer. To teach advanced applications, more sophisticated software and/or hardware is required.

Former methods of typing and storing information on paper (hard copy) are giving way to word processing with keyboarding at an electronic keyboard. Each keystroke, whether it be space, character, symbol, or code, becomes a digital impulse stored for future use. Traditional typewriters are being replaced with such electronic keyboards available on electronic typewriters, managerial workstations, word processors, and



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computer terminals.

The cost of technology is decreasing steadily and at the same time such technology enhances and eases the keyboarding and written communications process greatly. As a result, millions of office workers (both new employees and those presently employed) currently using typing skills will need to develop and refine their word processing knowledges and skills.



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# OPTICAL DATA TRANSMISSION AND OFFICE WORKERS

by
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Optical (or fiber-optic) data transmission involves the use of optical fibers (sometimes known as guided-wave optics) to transmit signals in the form of light rather than as electrical currents. Virtually all types of information, including voice, data and video signals, can be encoded for optical transmission. This new technology is finding increasing use because for many applications it offers significant advantages over transmission of signals electrically. Attractions of optical transmission include: larger information-handling capacity, longer-distance transmission when operating at high capacity, small size and weight, ease of installation in existing facilities, high security, freedom from sparks and explosion hazards, and immunity to electromagnetic noise and lightning damage.

The office worker literally will not see optical fibers, which will be housed in cables similar in appearance (although smaller in size) to ordinary electrical cables. This invisibility of the fibers is symbolic, because the impact of optical data transmission on the office worker will be indirect, due not to the optical technology itself, but to other developments made possible by the use of optical transmission. For example, the Grumman Corporation has used optical fibers to interconnect terminals and a computer system which stores, retrieves and alters engineering drawings. The result has had a significant impact upon the work of drafters, but the primary cause of that impact is the computer system, although installation of the optical transmission system was necessary for the computer system to work.



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In more general terms, the spread of optical transmission may increase the use of video displays for images as well as for alpha-numeric characters. Other consequences which could affect office workers include wider dispersion of terminals, including some at locations previously considered unsuitable because of problems with electronic transmission.

Knowledges and skills required for effective use of the systems made possible by optical transmission depends on the particular systems chosen. The same is true for the special equipment and facilities required for teaching office workers.

Since the impact of this technology on the office worker is indirect, educators need consider not optical fiber technology itself, but the new office and communications system that depend on the technology. For example, integrated office information systems can make use of fiber optic cable to efficiently transmit information (textual, numeric, or graphic) to and from various terminals--including microcomputers and word processors--connected by cable to a main computer housed at another location within the complex. To take full advantage of these capabilities, office workers will need to understand how to interact with local distributed data handling systems. Installation of one of these modern systems can be very expensive, but the concepts and skills required may be taught by simulation, using microcomputers already available at many educational institutions. On-the-job training for particular systems will still be required to supplement workers' general competencies.



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Optical transmission is growing rapidly, but largely in areas invisible to the public at large and office workers in particular. For example, the Bell System plans to install over 100,000 kilometers of optical fiber this year to carry telephone calls between switching offices, an application vital to the telephone industry but nearly invisible to telephone users. Office-scale fiber-optic systems such as that described above are few and far between now. They are likely to become more common over the next few years, but will almost certainly remain a small minority of office communication systems.

Optical fibers have the technological potential to permit two-way video transmission to homes, and that capability has already been demonstrated in Japan. Such a capability would allow many people who now work in offices to work at home using a two-way video workstation. However, problems with regulations, software, economics, and customer acceptance loom large, and such systems are unlikely to prove practical and come into common use before at least a decade has passed.



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# THE OFFICE OF THE FUTURE - CHANGES IN WORKER TRAINING

by
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The Office of the Future is no longer in the future. Already, in the early 1980's, profound changes have begun shaping the way we participate in our day-to-day work, at every level of the office workforce. Starting in the mid-1960's, computer-based technology began to emerge from the computer room and to affect (mainly in a positive way) the way in which office workers process work.

Initially, through all of the 60's and most of the 70's, this impact was largely related to the acceptance and spread of the use of word processing technology. Given that across all categories of secretaries and kinds of industries, about 20% of secretarial work is in the typing area (and that about one-half of typing can be greatly enhanced by using word processing equipment and techniques), word processing was significantly affecting about 10% of some secretaries' work.

But only about 6% of the office work force does secretarial work--and not every secretary (in fact, less than 15% of all secretaries) has received word processing equipment to date. This means that the total effect of this single office automation technology has so far had only a small effect on overall office productivity. Even if every secretary had her typewriter replaced with an agile word processor, only about 1% of office work would be enhanced.

Therefore, much more emphasis has been placed lately on the advantages of placing computer technology much more broadly in the office

workplace. The term Office of the Future or Office Automation is generally used to describe this ongoing process.

While some believe Office Automation is simply the use of computer-based technology to support office work, that is far too simplistic a definition. Office Automation has several aspects:

- The use of computer-based work stations;
- Proliferation of these work stations throughout the office workplace, to every worker, at every level--from secretaries and clerks through administrative staff and professionals, to executives;
- Offering a broad set of office functions including but not limited to:

  Word Processing and Text Authoring

  Electronic Mail

  Electronic Filing

  Administrative Support (calendars, schedules, reminders)

  Data Base Access

  Desktop Computing

  Business Graphics

- Interconnecting all users in an interactive, on-line environment to permit easy communication and data sharing.

To permit this profound alteration of the <u>way</u> we work, several stages will have to be passed through:

<u>Education</u>: The general computer literacy of the entire population will have to be raised. By the end of this century it will be difficult to function in a developed country without being able to use a computer terminal. This will be a two-part effort: we have to provide computer literacy education to every current and future student in our educational institutions at every level <u>and</u> we will have to provide a



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kind of "re-training" in computer literacy to every worker now in the workforce. NOTE: Being educated in computer literacy does not mean teaching everyone how to program. That effort would be analagous to requiring that every student driver learn to repair internal combustion engines. It does mean teaching everyone to use computers and computer software at a level appropriate to their functioning in the society.

Orientation: Teaching the members of a business organization how that organization and their jobs will change as a result of increasing levels of computer usage. Here the emphasis is on the individual and his business organization, but at the level of "how" and "why" rather than at the level of "how to."

Training: Teaching each worker how to use his new work tools. This will be a stepping process with more workers and increasingly complex (and useful) tools available at every step in the process. This change process cannot be undertaken in a single step--it wouldn't work--and, in any case, continuing advancement in the technology will require continuing rethinking of the entire process and continuing changes in the way we work.

The schools have a major part to play in the Office of the Future. First, it is their job to provide computer literacy training to every student. We should not be graduating any more high school seniors, starting this year who are not minimally computer literate. Also, we need to provide early stages of training and career counseling for students who will become the analysts, designers, and managers of the automated office.

Secondly, schools need to de-emphasize certain skills which are now less important (like error-free typing and precision mathematics), because machines now help us in these areas, and to emphasize other skills which machines will not do well (or perhaps ever) in areas like analysis and judgment. Because the technology will change continually over the career lifetimes of our current students, we need to teach them an acceptance of change, even a willingness to welcome it. Also, we need to teach skills which are useful and supportive through a sequence of technological implementations, rather than limited to the skillful use of a particular piece of this year's technology.

Thirdly, the schools need to serve as a focal point for providing retraining in both computer literacy and in specific job-related computer skills to the entire population of existing office workers, at every level of the workforce. This is absolutely required in order not to sadly neglect much of our existing workforce.



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# ALTERNATIVE WORK SCHEDULES

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Companies increasingly are seeking creative ways of adapting to a changing work environment, one characterized by a dramatic increase in the number of women in the work force and a corresponding increase in the number of dual earner families, a gradually aging work force, a declining supply of younger workers, and new technology. One of the strategies being considered is adoption of new work scheduling arrangements that can meet changing organizational and employee needs.

Alternative work schedules take a variety of forms. In some arrangements, the number of hours worked remains constant, with variations in starting and stopping times or with a compression of the week into fewer days. Other approaches provide for fewer working hours, usually at a reduced salary. The common element shared by many alternative work schedule plans is the sense of control workers gain as their work schedules are adjusted to be more in keeping with their personal needs.

The arrangements highlighted in this article--flexitime, permanent part-time, and job sharing--were chosen both because they show how companies design programs that respond to changing work force and business needs and because implementation of these arrangements is likely to increase during the next decade.

## FLEXITIME

Flexitime is a work schedule that leaves the standard number of working hours unchanged but allows employees some choice of when to



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start and stop working. Flexitime arrangements are known by many names--flexible work hours, variable work hours, gliding time, flexible day, flexitour, floating day, best time, and maxiflex, to name a few.

There is no one established flexitime arrangement. They vary, for instance, in the degree of flexibility employees are allowed (some organizations permit workers to change schedules from day to day, while others require that the schedules, once chosen, remain fixed). Each program is tailored to the needs of the implementing organization, its employees, and the community. Benefits and problems for companies or workers also vary. Nonetheless, a review of the successful experiences of hundreds of organizations that have implemented flexitime reveals some patterns of benefits. Many companies, for example, report increased employee morale and job satisfaction, improved management practices (attributed to better planning and improved supervisory techniques), improved productivity (resulting from fewer short-term absences and less tardiness and from a task-oriented approach to work), and cost savings (from reduced turnover and overtime).

In deciding whether to adopt flexitime, an organization must first define its overall as well as specific program objectives and then determine whether the program is feasible in all or part of the organization. The work technology and types of jobs involved and degree of interdependence among employees and work units are among the considerations. Supervisors should be involved in the development of the program, and they may need special training in ways to ensure adequate coverage and communications. For those supervisors accustomed to telling employees what to do and when, where, and how to do it, flexitime, at least initially, requires a substantial adjustment.



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A simple maxim has emerged from the experiences of the few firms that have discontinued flexitime programs--managers must manage, even if their style is significantly different. That is, managers and supervisors must be sure the organization's operating needs are met. To illustrate, an east coast firm conducting a substantial portion of its business with clients on the west coast requires late afternoon phone coverage. If most workers choose early flex times, adjustments must be made, possibly through an employee-selected rotation system or through new program limitations or restrictions. If business needs are overlooked, the programs may ultimately be terminated as a failure.

Flexitime offers workers many benefits--greater control over their work hours, easier commuting due to the ability to travel during off-peak hours, a better fit of non-work time with personal needs, among them. But with these gains come additional responsibilities. Beyond the more obvious ones of not abusing the system and setting work goals by task rather than by the clock, participating workers need to recognize that a program can be maintained only if it meets the organization's business needs and that they can seek, independently or with co-workers and supervisors, solutions to problems that arise.

According to the May 1980 supplement to the Current Population Survey published by the Bureau of Labor Statistics (BLS), approximately 7.6 million American workers employed in full-time, nonfarm wage and salary jobs (or about 12 percent) are on flexible schedules that permit them to vary the time they begin and end their work days. Other surveys show that many organizations are giving flexitime preliminary or serious considerations. Work in America Institute predicts that by 1990, 25

percent of full-time nonfarm workers in the United States will be on flexitime.

The BLS survey further shows that flexitime is most common among white collar workers, with recent growth among clerical and service workers. Work technologies that call for a great deal of interdependence among workers and work units (for example, production units with assembly lines and multiple shifts) are generally acknowledged as presenting the biggest obstacles to flexitime implementation.

PERMANENT PART-TIME AND JOB SHARING

In permanent part-time arrangements, employees voluntarily work substantially fewer hours a day or fewer days a week than full-time employees. However, both the job and the worker are considered regular and stable by the company. Usually, permanent part-time offers opportunities for career advancement and participation in the fringe benefits package, generally on a prorated basis. Job sharing is a form of permanent part-time in which two or more workers share the responsibilities of one full-time job. It is likely that, in this time of budget tightening and high unemployement, reduced work hour arrangements such as these will be used increasingly to meet economic and other business objectives. Companies have adopted permanent part-time programs for specific reasons--to adjust to skill shortages, to reduce absenteeism, to ease recruitment problems, to improve efficiency, or to adjust to budget restrictions. For example, a small manufacturer experiencing a shortage of entry-level assemblers successfully turned to people in the community who wished to work only four to six hours a day. A mid-sized manufacturer expanded its formal job sharing program from



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one team in 1977 to 43 teams by 1982 because it has reduced absenteeism and met employee needs. Still another company, a large manufacturer with a zero growth policy, decided to use part-time to improve company productivity by arranging workloads more efficiently.

Permanent part-time can make management more complex, and coverage, scheduling, communication, accountability, and fringe benefits must be considered. Successful implementation required careful planning, but these obstacles are not viewed as insurmountable where programs are meeting company objectives. One benefit cited by management is that supervisors often gain a clearer understanding of their staff levels and workload needs.

Permanent part-time and job sharing offer workers a chance to spend more time with their families, pursue education or a new vocation, or have additional leisure time. There are some tradeoffs, however, in addition to the obvious reduction in income. Some companies offer no fringe benefits to part-timers, and only a small percentage offer full coverage. (More often, companies offer part-timers the same benefits available to full-timers, but on a proportional basis.) Further, it may take twice as long for a half-time worker to be considered for merit increases and promotions as a full-time worker. There may also be limits on the types of positions the company will make available to those on less than full-time schedule. Part-timers may also be the first group of workers to be laid off. It is important for part-timers to try to attain some balance between demonstrating a committment to their jobs (by attending critical meetings on off days, for example, or by taking care to ensure adequate communication with supervisors and

co-workers) and avoiding an exploitive arrangement.

These alternative work scheduling arrangements--flexitime, permanent part-time, and job sharing--are being used in a large number of companies in the United States to meet diverse business, operational, and social needs. The offer companies more flexibility in adapting to a changing work environment and employees the opportunity to adjust their work lives to meet family demands and personal needs. It is likely that they, and possibly other new work arrangements (notably sabbaticals, or paid time off, often used in high-technology industries to avoid employee burnout), will be used increasingly in the future.



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# WORKER PARTICIPATION IN MANAGEMENT: QUALITY CIRCLES

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This paper addresses a specific worker participation strategy commonly known as Quality Circles. Quality Circles is a process in which a group of employee volunteers use specific techniques to identify and resolve work-related problems. While Quality Circles is the most common name for these problem solving groups, other names are also used, including participative action circles, participation teams, involvement teams, and quality control circles. While Quality Circles can be implemented in any working environment, this paper concerns the role of office-identified workers who may implement and facilitate a Quality Circles program. The primary focus of this discussion will be the impact of Quality Circles on Office Supervisors/Managers and Personnel and Training Specialists.

## What Are Quality Circles?

As a process, Quality Circles is not just another form of employee suggestion system. Quality Circles is not a typical employee meeting. Quality Circles is a formalized set of procedures for identifying and solving work-related problems. The procedures are based on certain assumptions about people and organizations. These assumptions might be stated as follows:



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1. No one knows the job better than the person who performs the work;

2. Employees are able and willing to develop ideas for performing the work more efficiently and effectively;

3. In order to tap these ideas, there must be a formal mechanism that encourages and assists employees in making improvement recommendations to management.

The basic Quality Circles unit consists of 6-12 volunteer members, usually from the same work area. The leader of the circle normally is the supervisor of the work group. A facilitator is a person outside the work group (e.g., training or human resource specialist) who assists the leader and acts as the administrator of the Quality Circles process throughout the organization. A single facilitator may facilitate 10-15 Quality Circles. The Quality Circle organization may consist of a Steering Committee (composed of management and union representatives who establish direction and policy for the Quality Circles process), one or more facilitators, circle leaders, and members.

The process by which Quality Circles operate can be considered a series of seven ordered steps:

1. Identify Problems--The circle members, management, or non-members may suggest a list of possible problems for the circles to investigate.

2. Select One Problem--Circle members use group decision techniques to select one problem from the list. Only circle members and their leader participate in problem selection. Members may gather data to help them determine the severity of problems and the potential benefits to aid their problem selection.

3. Analyze The Problem--Members use specific analytic techniques to determine potential causes and to select the most likely cause of the problem.

4. Develop Solutions--Once the cause has been identified, members use specific techniques to identify and analyze alternative solutions. This may include a pilot implementation process to verify a solution.



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5. Present to Management--Members present their recommendations to management in a formal presentation. They support their cause using charts and graphs to summarize the data gathered by the circle. The presentation includes a cost-benefit analysis of the recommended solution(s).

6. Implement Solution(s)--If management accepts the recommendation of the circle, the solution is implemented.

7. Evaluate Solution(s)--Circle members periodically evaluate the implemented solution to insure that the problem has been solved.

Throughout these seven phases members receive training in and use techniques such as brainstorming, nominal group techniques, cause and effect analysis, Pareto analysis, data gathering (e.g., check sheets, check lists, interviews, etc.), charts and graphs (e.g., histograms, pie charts, process control charts, etc.), and sampling procedures.

Work Activities Which Involve the Technology

Office Supervisors/Managers. Quality Circles will have an impact on the work activities of office supervisors and managers. This impact will be different for managers who have Quality Circles under their area of responsibility and for those who participate as Quality Circle leaders. For the purposes of this discussion, it will be useful to consider an office setting with a department manager who is responsible for four sections, each headed by a supervisor. Typically in this type of organization, a section supervisor would be the Quality Circle leader and the members would be clerks who report to that supervisor. How will Quality Circles affect the work activities of the department manager and the section supervisor?

The role of the department manager with respect to Quality Circles is to establish a management climate that will permit successful

circle operation. In terms of specific work activities, this may include:

- attending a management overview of the Quality Circles process;
- demonstrating his/her understanding and support of Quality Circles through statements made in staff meetings, in informal contacts with subordinates, and in written statements to members of the department;
- attending circle meetings;
- receiving periodic briefings from the circle leader about progress and problems of the circle;
- reporting on the progress of the department's Quality Circles to higher management;
- budgeting and allocating sufficient resources and space to enable the circle to carry out its work and to implement its recommendations;
- incorporating Quality Circles objectives in the annual business plan;
- evaluating the impact of Quality Circles on the department in terms of intangible (e.g., attitudinal measures) and tangible (e.g., productivity, cost savings, absenteeism, etc.) results;
- assisting the circle leader in publicizing the accomplishments of circle members within the organization; and
- providing personal recognition to individual circle members for their accomplishments.

The section supervisor who is a Quality Circles leader will be an active circle participant. In terms of work activities this may involve:

- Attending leader training
- planning and preparing an agenda for circle meetings;
- training circle members in the use of circle techniques and using the techniques effectively;
- conducting a group meeting;

- coaching individual circle members;
- informing nonmembers in the work group of the circle activities;
- communicating circle activities, progress and problems to the department manager;
- receiving coaching from the circle facilitator;
- representing the circle to other groups within the organization and outside;
- scheduling the normal work of the section to allow circle members to have time to meet regularly; and
- demonstrating enthusiastic support for circle activities.

Personnel and Training. For the sake of this discussion, personnel and/or training specialists will be assumed to be the Quality Circles facilitators. As such, the process will have a significant impact on their work activities. New tasks will involve:

- attending facilitator training;
- participating in Steering Committee meetings;
- conducting training for circle leaders;
- "coaching" leaders on performance as a group leader;
- publicizing Quality Circles inside the organization;
- publicizing Quality Circles to individuals and groups outside the organization;
- maintaining records of circle activities;
- arranging logistics for and attending circle meetings;
- reading outside materials and bringing new ideas to the circle leaders;
- linking the Steering Committee, leaders, managers and members together in a communication network; and
- developing new training materials.

Knowledge and Skills Required for Completion of Required Work Activities

There is some "core" knowledge that all the target groups should possess. These include:

- the meanings of productivity and quality of working life and their interrelationship;
- the meaning of productivity as it relates to the specific organization and work group;
- basic concepts of productivity measurement;
- elements of the productivity improvement process;
- role of Quality Circles in the productivity improvement process; and
- Quality Circle basic and advanced techniques.

Common skills that all target groups should possess include:

- listening;
- coaching subordinates; and
- developing and using measures of organizational performance.

Additional skills required by the target groups are listed below:

Section supervisor (circle leader) skills:

- planning and running effective group meetings;
- using Quality Circles techniques; and
- training others to use Quality Circles techniques.

Personnel and training specialists (facilitators) skills:

- developing and using training materials;
- using Quality Circles techniques;
- training others to use circle techniques; and
- public speaking.



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Growth and Trends in the Diffusion of the Technology

Quality Circles have been well established in Japan since the 1960's. The first introduction of Quality Circles in the United States occurred at Lockheed in 1974. By 1980, over 500 U.S. organizations had started Quality Circles (Ingle, 1982). According to the International Association of Quality Circles (IAQC), as of 1982, at least 2,500 U.S. organizations have Quality Circles. The IAQC now has over 5,000 members. To illustrate the spread of Quality Circles in one organization, Westinghouse Electric Corporation was one of the first U.S. corporations to implement the process. The first circles were formed in Baltimore in 1976. As of the end of 1981, Westinghouse expected to have at least 1,000 circles in operation. Continued exponential growth is expected in both the public and private sectors during the 1980's.

# CHAPTER III

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51 Flexitime's potential for management
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67 Union attitudes and the "manager of the future"
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On-line efficiency is key to survival. Purchasing, 1981, 91 (6), 79-83.

Describes the efficiency advantages of computers in order processing. Gives examples of training and organizational approaches geared toward the enhancement of workers' skills in interacting with computer-supported order/inventory systems.

Patterson, W. P. Who will keep the computers running? Industry Week, November 2, 1981, pp. 46-51.

Topics discussed: Statement of the problem--proliferation of computers and dearth of skilled maintenance personnel. Costs skyrocketing; companies and agencies pushed by vendors to do some of their own maintenance. Quotes on salaries, service rates, etc. Advent of vendors' remote diagnostic centers and computers diagnosing one another. Computer companies haven't gone all-out to expand their training programs. Tech schools turn out qualified people for whom there is tremendous competition.

Pauly, D., Contreras, J. and Marback, W.D. How to do it better. Newsweek, September 8, 1980, p. 59.

The notion of the "quality circle" wherein small teams of labor and management people are put together in a nonhierarchical setting and asked to spot and solve problems on the production line was developed in the United States in the late 1940's, but has found widespread acceptance and success in Japan. It is another tool for promoting productivity.

Quality control circles at Westinghouse: A success story. The Maryland Workplace, (Newsletter of the Maryland Center for Productivity and Quality of Working Life), November/December 1979, 1 (5), 1-2.

Concise discussion of such questions as: What is a Quality Circle?; Who can use Quality Circles?; What's in it for the company?; What's in it for the Circle member?; Who's doing it?; Why the great interest in Quality Circles?; Are Quality Circles for manufacturing employees only?; What are the limitations?; and How would a company start a Quality Circle Program?

Rilson, J.B. The automated office arrives. Telephone Engineer and Management, 1981, 85 (6), 53-70.

Describes the enhanced cabilities of PBX systems possible due to microelectronics. Indicates uses of "intelligent" user-programmable PBX systems for handling other than voice communications and for user-controlled networking. Growth and trends for the PBX market are shown.

Roworth, D.A.A. Fiber optics for industrial applications. Optics and Laser Technology, 1980, 12, 255-259.

Overviews current and expanding areas of fiber optics use (e.g., in communications), and predicts growth in local industrial communications usage. Fiber optic data transmission is described technically.



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Tsichritzis, D.C., and Lochovsky, F.H. Office information systems: Challenge for the 80's. Proceedings of the IEEE, 1980, 68, 1054-1059.

Office information systems are described, especially with reference to problems and bottlenecks to implementation. User

Vail, H. The automated office. The Futurist, April 1978, pp. 73-78.

Automation has already revolutionized the factory. Now it is about to revolutionize the office -- freeing workers from rigid schedules, busy work, and the aggravations of commuting.

The telephone is now speeding the development of the electronic office. Today's worldwide telephone network means that portable computer terminals can be carried and used almost anywhere. Word processing equipment is revolutionizing the way in which letters and other documents are written, corrected and reproduced.

Wiederhold, G. Database technology in health care. Journal of Medical Systems, 1981, 5, 175-196.

The use of database management systems (DBMS) in various medical and health care management applications is treated. Such systems and operator interfaces are generally described.

Wohl, A.D. Office of the future--Close, but still elusive. The Office, January 1981, 93 (1), 93-94, 190.

Office is a dynamic place and its future is a dynamic, not a static goal. Changes in technology offerings, but also changes in attitudes and goals. Word processing--many firms saying they want to fit word processing into existing traditional secretarial structures (Has to get cheaper because sec. will use it only 20 percent of workday) or has to support a lot more than the typing function--Both of these things are happening; not just word processing anymore--has grown into local data processing, photocomposition and administrative services. Office automation recognized as a key component in increasing office productivity.



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